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U.S. Armed Forces - NRC Vision Committee

MINUTES AND PROCEEDINGS

of the fourth meeting of the

ARMY - NAVY - OSRD VISION COMMITTEE

July 27, 1944

Room 4E-592, The Pentagon
Washington, D.C.

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BY Floyd R. Stewart DATE June 25 74
Acting Phys. Sec. Officer, NIH

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ARMY - NAVY - OSRD VISION COMMITTEE

MINUTES

Fourth Meeting
Room 4E-592, The Pentagon
1000, 27 July 1944

The following were present:

ARMY	AAF	Lt. A. Chapanis, Aero Medical Laboratory, Wright Field
		Dr. William O. Jenkins, Office of the Air Surgeon
		Major Claude M. Terrell, Training Aids Division
	AGF	Lt. Col. A. L. Sanford, Army War College
	AGO	(M)Dr. E. R. Henry
		(CM)Dr. W. V. Bingham
	Engrs	(M)Major S. K. Guth
	Ord	(A)Mr. John E. Darr, Jr.
	QMG	(A)Captain R. M. Toucey
		Dr. Glenn A. Millikan, Consultant, QMG, Johnson Foundation
	Sig	Dr. James H. Elder, Office of the Chief Signal Officer
	SG	(M)Lt. Col. W. L. Cook, Jr.
	WDLO	(M)Captain H. E. Clements
		Major H. Noble, War Department Liaison Office with NDRC
NAVY	CominCh	(M)Lt. Comdr. R. E. Burroughs
		(A)Lt. S. H. Britt
	BuAer	(CM)Lt. Comdr. David Leavitt
		Lt. (JG) Joseph Herzman, Training Films Branch
	BuMed	(M)Captain J. H. Korb
		(A)Lt. Comdr. R. H. Peckham
		(CM)Dr. Harold F. Blum
		Lt. John A. Bromer, Aviation Psychology Section
		Lt. Comdr. R. H. Lee, Naval Medical Research Institute, Bethesda
		Comdr. W. N. New, Medical Field Research Laboratory, Camp Lejeune, N. C.
		Lt. (jg) H. J. Older, Aviation Psychology Section
	BuOrd	(A)Lt. (jg) Nathan H. Pulling
		(CM)Lt. Edgar O'Neil
	BuPers	(A)Lt. R. N. Faulkner
		Lt. Comdr. Paul A. Jone, Standards and Curriculum Section
		Lt. John J. McCarthy, Training Division
		Lt. Comdr. I. E. Merrick, Training Division
		Lt. (jg) John C. Snidecor, Standards and Curriculum Section
		Lt. Carroll P. Stinson, Training Division
	BuShips	(A)Lt. Urner Liddel
		Ensign Aline M. Arceneaux, Submarines
		Lt. (jg) Charles G. Hamaker
	I C Bd	(M)Lt. George W. Dyson
	SubBase	(M)Captain C. W. Shilling
	SONRD	Ensign Mary E. Wallace, Office of the Coordinator of Research and Development

NAVY	ATC	Lt. R. E. Blackwell, Amphibious Training Command, Norfolk
		Lt. John H. Sulzman, Amphibious Training Command, Norfolk
	CNO	Lt. C. D. Coffman, Recognition Section, Aviation Training Div.
	NTS	Lt. H. B. McFadden, Naval Training School (Recognition) Ohio State University
	USMC	Major C. Keller, Jr., Division of Plans and Policies, U. S. Marine Corps
OSRD	NDRC	(M)Dr. Theodore Dunham, Jr.
		(CM)Dr. F. E. Wright
		Dr. S. Q. Duntley, Section 16.3, M.I.T.
	APP	(M)Dr. H. K. Hartline
		Dr. Lyle H. Lanier, Project N-115, Princeton
		Dr. W. C. H. Prentice, Project N-115, Princeton
		Dr. Carl Wedell, Project N-115, Princeton
		Dr. Dael L. Wolfle, Member, Applied Psychology Panel
	CMR	(M)Dr. Walter Miles
	NRC	(CM)Dr. Selig Hecht
	OSRD	(M)Dr. D. G. Marquis

1. The chairman called for corrections or alterations in the Minutes and Proceedings of the third meeting which had been distributed by mail. The following correction was made: On p.35, last line, 623 m μ should read 465 m μ.

2. Members reported actions taken since the last meeting with respect to the distribution and utilization of red adaptation goggles (Minutes, third meeting, item 2, pp. 6-7). 9*

3. Lt. Comdr. Peckham reported on the progress of the Subcommittee on Sun-scanning Goggles in the development of new models (Proceedings, third meeting, p. 15). Preliminary models of (1) goggles for aviators and (2) variable density goggles for ground crews devised by Dr. Miles and Lt. Comdr. Peckham for field trials on July 31 were exhibited. The field trial results will be reported at the next meeting. 10

4. Further information on the problem of protection against excessive solar radiation (Minutes, third meeting, item 7, pp. 7-8) was presented by Dr. Blum. Present data permit a tentative and approximate statement on the limit of total energy transmission necessary to prevent eclipse blindness, but cautious human experiments are recommended in order to formulate satisfactory requirements. An inquiry from AAF concerning the special problem of ultraviolet radiation at high altitudes was referred to Dr. Blum for study. 13

*Numbers at the right refer to pages in the Proceedings on which the full report or discussion is presented.

5. Dr. Hecht discussed some preliminary data from his work on the influence of prolonged bright illumination on subsequent dark adaptation (Minutes, second meeting, item 8c, p. 5). A complete report with recommendations will be made later. 22

6. As a guide to the procurement of sun glasses by QMG, Capt. Toucey referred eight specific questions regarding the use and requirements of sun glasses to the Committee. Members were requested to write out replies for each question on which they felt qualified. 23

7. Lt. Comdr. Leavitt stated that the Plastic Section, Bureau of Aeronautics, needs a test procedure for the optical inspection of curved plastic for aircraft. No action was taken pending further information. 24

8. Captain Korb discussed the work of Air Commodore Livingston, RAF, on the mapping of visual fields under scotopic illumination and recommended his technique for consideration as a test for night vision. 25

9. The Vision Committee has been working with Project N-115, Applied Psychology Panel, NDRC, (Minutes, third meeting, p. 8) on the preparation of material useful in the training of night lookouts.

A. Dr. Wedell, recently returned from a field study of night lookouts on surface craft, described the procedures used and suggested ways of improving lookout performance. 26

B. Dr. Lanier asked the Committee members for their written criticisms of the series of statements "Factors Influencing the Efficiency of Night Lookout." These statements were formulated to provide a basis for the preparation of manuals and training aids for Naval night lookouts. Comments should be forwarded to the secretary for compilation.

10. Recognition Training

A. A discussion of recognition training programs in the various services was introduced by Lt. Col. Sanford, who told the Committee about the formation and function of the Recognition Subcommittee, Joint (A-N-Allies) Clearing Committee on Army and Navy Training Aids.

B. Lt. Coffman outlined the history and present organization of recognition training in U. S. Naval Aviation. 28

C. Lt. McFadden concurred in the presentation by Lt. Coffman and prepared a statement concerning the Navy recognition training program for inclusion in the Proceedings. 30

D. Major Terrell discussed recognition training in the Army Air Forces. 31

E. Examples of recent research studies in recognition training by the Psychological Test Film Unit at Santa Ana were presented by Dr. Jenkins. 37

After discussion and clarification of the problems involved in recognition and lookout training in the various services, it was agreed that a subcommittee be appointed to consider the following questions:

(1) Is recognition possible under conditions of night illumination, and what are the limits of recognition in reduced illumination?

(2) Is the task of night recognition sufficiently different from daytime recognition to require special training?

(3) What methods and aids can best be used in training for night recognition, and what weight should be given to the various phases of the training?

ARMY - NAVY - OSRD VISION COMMITTEE.

PROCEEDINGS

Fourth Meeting
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2. DISTRIBUTION AND UTILIZATION OF RED ADAPTATION GOGGLES

Digest of discussion:

At the last meeting of the Vision Committee, members agreed that action should be taken to insure widespread and proper use of dark-adaptation goggles. The chairman asked for reports of any progress made in this direction.

Lt. Hamaker reported that he had requested the Bureau of Supplies and Accounts to include instruction sheets with each package of goggles. This change of procedure will become effective with future procurements.

Lt. Comdr. Burroughs reported that an increase in the allotment of dark-adaptation goggles for amphibious craft is in process although the craft have not yet been equipped with the increased number.

Dr. Miles observed that the instructions on the kit containing the goggles should be more complete. Others pointed out, however, that very little can be added to the instructions now provided, which give a simple factual explanation of the use of the goggles. In addition, movies and pamphlets on vision have been used to instruct personnel in the use of goggles. Lt. Comdr. Peckham stressed the need for instructions attached to the equipment itself so that they cannot be discarded. Other media can supplement but cannot substitute for an explanation of the use of the goggles which is available to each wearer at the time of actual use.

3. DESIGNS FOR SUN-SCANNING GOGGLES

The following report of the Subcommittee on Sun-scanning Goggles was prepared by Lt. Comdr. R. H. Peckham:

1. Materials for sun-obscuring strips on goggles:

a. Printing on plastic has been to date unsuccessful. The ink has a tendency to clump, and therefore does not yield good optical qualities.

b. Metallic films on plastic have been to date unsuccessful, although experiments are still in progress. The metal is more brittle than the plastic, and a good pattern quickly breaks into pin-holes and scratch-like breaks when the plastic is bent.

c. Cemented laminations have been unsuccessful. The optical properties of the sun strips are lost in the cementing process.

d. Edge lamination has been successful, although this process results in a narrow (.080") frame around the assembly. This process is sufficiently good to warrant the preparation of samples for field testing.

2. Mechanical description:

a. Aviation type. The rubber-and-chamois frame called "Polaroid M-1944" was chosen to support the sun-scanning device. A clear plastic lens (1) is placed in the frame. Over this, as a "fit-over," is placed a neutral 30% transmission plastic lens. (2). This lens serves as a shield for glare from the sides of the visual field, but does not reduce vision to a noticeable degree. It can be easily removed for dawn and dusk operations.

The sun-scanner proper is a rectangular snap-down visor, 120 mm. x 60 mm. in size, which is hinged at the top. This hinge can be attached to the M-1944 frame without any changes in the frame specifications. The visor consists of a polarized (axis vertical) neutral plastic sheet of 12% transmission in front (3) and a yellowish plastic sheet of 91% transmission in the back (4). Between these two members a vertical bar of plastic, 8 mm. x 30 mm, transmitting 0.02% (5), is placed with its center line 28 mm. from the right edge of the visor. This bar protects the right eye. A second bar of the same material (5), 8 mm. x 42 mm, is placed horizontally, extending inwards from the left edge with its center line 22 mm. below the top of the visor. This bar protects the left eye. In use, each eye is obstructed by one of the bars. The two obstructions cover corresponding retinal points in the two eyes to form a square, which is effectively 10° wide. The head must be held so that the image of

the sun lies within this square. For searching or scanning the area of the sky near the sun, the head is moved so that the sun's image lies successively in each corner of this square. This has been found to be easy of accomplishment both while riding in a car on a moderately rough road and at sea in a small boat. The procedure is very easy when the observer is standing stationary.

b. Variable density type. The same sort of visor has been prepared for use in conjunction with the Variable Density Goggle (American Optical Company). In this design the bars are the same (5), but the density of the visor is high, consisting of a yellowish plastic (4) in front and a clear plastic (1) in back. Additional density is accomplished by means of the adjustment in this type of goggle.

3. Transmission:

The transmission requirements of sun-scanning equipment are of great importance. The eye is directed straight at the sun, and on clear days ultraviolet light must be excluded. All light including infrared must be reduced to acceptable limits, low enough to insure against retinal burn. Visual light must be attenuated in the whole visual field to comfortable intensity. Sufficient illumination must be preserved in all parts of the field to permit good acuity. The limits of visual transmission were determined by Dr. W. R. Miles, as reported in the Proceedings of this Committee, third meeting, p. 15.

The materials used are referred to by numbers above as follows: (Polaroid Corporation numbers.)

(1) XC92 - Non-polarizing clear plastic transmitting 92% of visual energy.

(2) XN30 - Non-polarizing neutral (nearly colorless) plastic transmitting 30% of visual energy.

(3) HN12 - Polarizing neutral plastic transmitting 12% of visual energy.

(4) XY91VO - Non-polarizing yellowish material transmitting 91% of visual energy but no ultraviolet below 400 millimicrons.

(5) XN.02 - Non-polarizing neutral (slightly orange) plastic transmitting 0.02% of visual energy.

The transmission of these assembled materials is shown in the table below, in per cent of original solar energy:

	A	B	C
	Visor and lens Background	Sun strips	Ocular media
Total solar energy	17.1%	0.23%	0.02%
Ultraviolet	0	0	0
Visible	4.2%	0.001%	0.0007%
Near infrared	25.7%	0.26%	0.067%
Water-absorbed infrared	37.3%	0.88%	0

A - Effective on conjunctiva and cornea
B - Effective on pupillary area of cornea
C - Effective at the retina (sun's image)

4. Field Trials:

Captain R. M. Toucey, of the QMG, has arranged for field trials of these two types of sun-scanning goggles at Camp Davis, N. C., on July 31. The results of these tests will be reported at the next meeting.

4. SOLAR ENERGY REACHING THE RETINA: PROPOSED SPECTRAL CURVE FOR TESTING SUN-SCANNING GLASSES

The following report was prepared and presented by Dr. Harold F. Blum. It is also issued under date of 1 August 1944 by the Naval Medical Research Institute, Bethesda, Maryland.

Introduction

Protection of the retina from "eclipse blindness," i.e., temporary or permanent scotoma resulting from looking directly into the sun, depends upon reducing the energy of sunlight which reaches the tissue to such an extent that the local temperature does not rise enough to cause tissue damage. All the energy that reaches the retina, ultraviolet, visible, and infrared, contributes to its heating. Since glasses used for sun-scanning do not transmit all wavelengths equally, it is necessary to consider the intensity of all wavelengths in order to estimate the total intensity reaching the retina. The accompanying spectral curves, Figure 1, and Table 1, have been prepared for this purpose.

The Proposed Curve

With an absorbing glass in front of the eye, the intensity of the radiation of a given wavelength λ, reaching the retina is as follows:

$$I_{r_\lambda} = I_{s_\lambda} O_\lambda G_\lambda M_\lambda \qquad (1)$$

where I_{r_λ} is the intensity of the radiation reaching the retina, I_{s_λ} is the intensity of the sun's radiation incident on the cornea, O_λ the fraction of the radiation transmitted by the ocular media, G_λ the fraction transmitted by the absorbing glass, and M_λ, a factor representing the concentration of the rays due to refraction at the various surfaces of the ocular media. Wavelengths from about 0.3 μ to 1.3 μ reach the retina, and the intensity of the total radiation is the integral of the intensities of all these wavelengths.

$$I_r = \int_{\lambda 0.3\,\mu}^{\lambda 1.3\,\mu} I_{s_\lambda} O_\lambda G_\lambda M_\lambda d_\lambda \qquad (2)$$

For convenience, and because of lack of data on the refraction of infrared wavelengths by the ocular media, M_λ will be considered to be a constant, the estimation of which will be discussed below.

$$I_r = M \int_{\lambda 0.3\,\mu}^{\lambda\ 1.3\,\mu} I_{s_\lambda} O_\lambda G_\lambda d_\lambda \qquad (3)$$

Values of $I_{s_\lambda} O_\lambda$, estimated for various wavelengths are presented in Table 1, and from these it is possible to calculate the value of of the integral in equation (3) if values of G_λ are available. The values of $I_s O_\lambda$ from the table are multiplied by the corresponding values of $G^{s_\lambda}_\lambda$, i.e., the transmissions for the particular sun-scanning glass under consideration; and the values of $I_{s_\lambda} O_\lambda G_\lambda$ are then plotted against λ. The curve so obtained shows the relative spectral distribution of the sun's radiation reaching the retina when this particular glass is used, and the area under the curve, which may be obtained with a planimeter, is the integral in equation (3). If no glass is present G_λ becomes unity and the value of the integral is then 430 watts m^{-2}.

If the value of the integral is multiplied by an appropriate value of M, an estimate of the intensity of the sunlight reaching the retina is obtained.

The method of obtaining values of $I_{s_\lambda} O_\lambda$, and M will be discussed below.

Estimation of the Values of $I_s O_\lambda$

The values of $I_s O_\lambda$ in Table 1 are based on certain estimates, the validity of which needs to be considered. The values of I_{s_λ} were obtained from the data for solar radiation assembled by Moon[1]. They are based on air mass 1 (sun at zenith), and dry air; and thus represent maximum conditions for sunlight. The values of O_λ were obtained from the data of Ludvigh and McCarthy[2], and Roggenbau and Wetthauer[3]. The former are transmissions of the whole human eye after removal of the retinal coats, and extend from 0.4 µ to 0.82 µ; the latter are transmissions of the cornea, aqueous humor, lens, and vitreous humor of the ox eye, and extend from 0.7 µ to 3.0 µ. The latter have been corrected in terms of the thicknesses of the various layers of the human eye, the thicknesses used being: cornea 0.6 mm., aqueous 3.0 mm., lens 3.6 mm., vitreous 15.8 mm. There is some discrepancy between the two sets of data at their overlap between 0.7 µ and 0.8 µ, which has been smoothed in obtaining values for O_λ. The data of Table 1 have been plotted as the heavy line in Figure 1. The dotted line in this figure was obtained by substituting transmissions of 23mm. of water for O_λ in the infrared region of the spectrum. The curves do not differ greatly, and it is possible that the infrared absorption spectrum of the ocular media is virtually that of water; since Roggenbau and Wetthauer's measurements were taken at fairly wide intervals, and

may have smoothed out the water absorption band at 1 μ. At any rate, the approximate agreement of the two curves lends confidence in the values presented in Table 1.

In Figure 2, solar radiation spectra for an atmosphere containing 20 mm. of water vapor, are plotted for air masses 1 and 2 (sun 60° from zenith). The areas under these curves are not much less than that under the proposed standard curve, indicating that the latter is about as good an estimate for bright sunlight in general as for maximum conditions.

Estimation of the Value of M

Estimation of the value of M is not too certain. Our estimate was made in the following way: the size of the retinal image was calculated on the basis of the schematic eye from the diameter of the sun (8.65×10^5 miles) and the distance of the sun from the earth (9.3×10^7 miles), the value obtained being 0.016 mm.^{2}. The "corneal" image for parallel light entering a pupil 2.6 mm. in diameter (the average diameter found by Eccles and Flynn(4) in sunlight) when dark glasses were worn, was estimated as 7.98 mm.^{2}, the focusing action of the cornea being taken into consideration. The ratio of the area of the corneal to the retinal image is approximately 500, and this was taken as an estimate of M.

This value being based on measurements with wavelength 0.59 μ (sodium D lines) should be high rather than low; since values of M_λ must be lower for longer wavelengths and higher for shorter wavelengths, and the latter predominating the average value of M_λ would probably be lower than this estimate.

Assuming the above value of M_λ, the intensity of the radiant energy incident on the retina when no protective glass is in front of the eye may be estimated as 21 watts per cm.^{2} or about 300 calories per minute per cm.^{2}. This is a very high intensity, but that it is not too far from the true value is indicated by the experiments of Eccles and Flynn(4) who obtained 70 calories per minute per cm.^{2} for the rabbit's eye in estimates based on the actual dimensions of lesions produced by direct exposure of the eye to the sun. The magnitude of this value may be grasped by noting that if this energy is all absorbed in a thickness of 0.2 mm., the approximate thickness of the retina would raise the local temperature about 250°C. per second, if there were no means for carrying away the heat. Verhoeff and Bell's(5) experiments on rabbits yielded similar results, although a direct comparison in terms of incident energy is difficult to make.

Estimation of the Minimum Protection Required

Eccles and Flynn(4) found that exposure of the rabbit retina to 70 calories per minute, per cm.^{2} for 2 minutes always produced severe lesions of the retina, whereas exposure to this intensity

for 10 seconds produced mild lesions in one-half the trials. One "doubtful" lesion was caused by 30 seconds exposure at 40 calories per minute per $cm.^2$, but 30 seconds exposure to 30 calories per minute per $cm.^2$ produced no lesions. All these intensity values are based on estimation of the intensity at the retina.

If it is assumed that the human eye is injured by the same intensities that injure the rabbit eye, the reduction of the intensity at the retina to 30 calories per minute per $cm.^2$ should prevent injury for periods up to 30 seconds. Since the calculated intensity for the human retina is about 300 calories per minute per $cm.^2$, this would mean that sun-scanning glasses which reduce the total intensity at the retina to one-tenth, should provide adequate protection for periods up to 30 seconds. This means that the calculated value of I_r should be less than 2.1 watts per $cm.^2$ or that the integral in equation (3) (estimated graphically as described above) should not exceed 43 watts m^{-2}.

The assumption that the human eye can tolerate the same intensity as the rabbit's eye may not be justified, and it should be noted moreover that Eccles and Flynn's[4] estimates are based on actual histological damage to the retina and that sun-scanning goggles should be designed to avoid the production of even temporary scotoma which might not be associated with observable cell destruction. Furthermore, the estimation of the value of M may be open to question. Hence, it seems that any value assigned for the minimum protection required of sun-scanning glasses should err on the side of conservatism, i.e. greater protection, until such time as more direct measurements are available.

References

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2. Ludvigh, E., and McCarthy, E. F.: Absorption of visible light by the refractive media of the human eye. Arch. Ophthal. (1938), 20: 37-51.
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Table 1

PROPOSED CURVE FOR CALCULATION OF SOLAR ENERGY AT THE RETINA

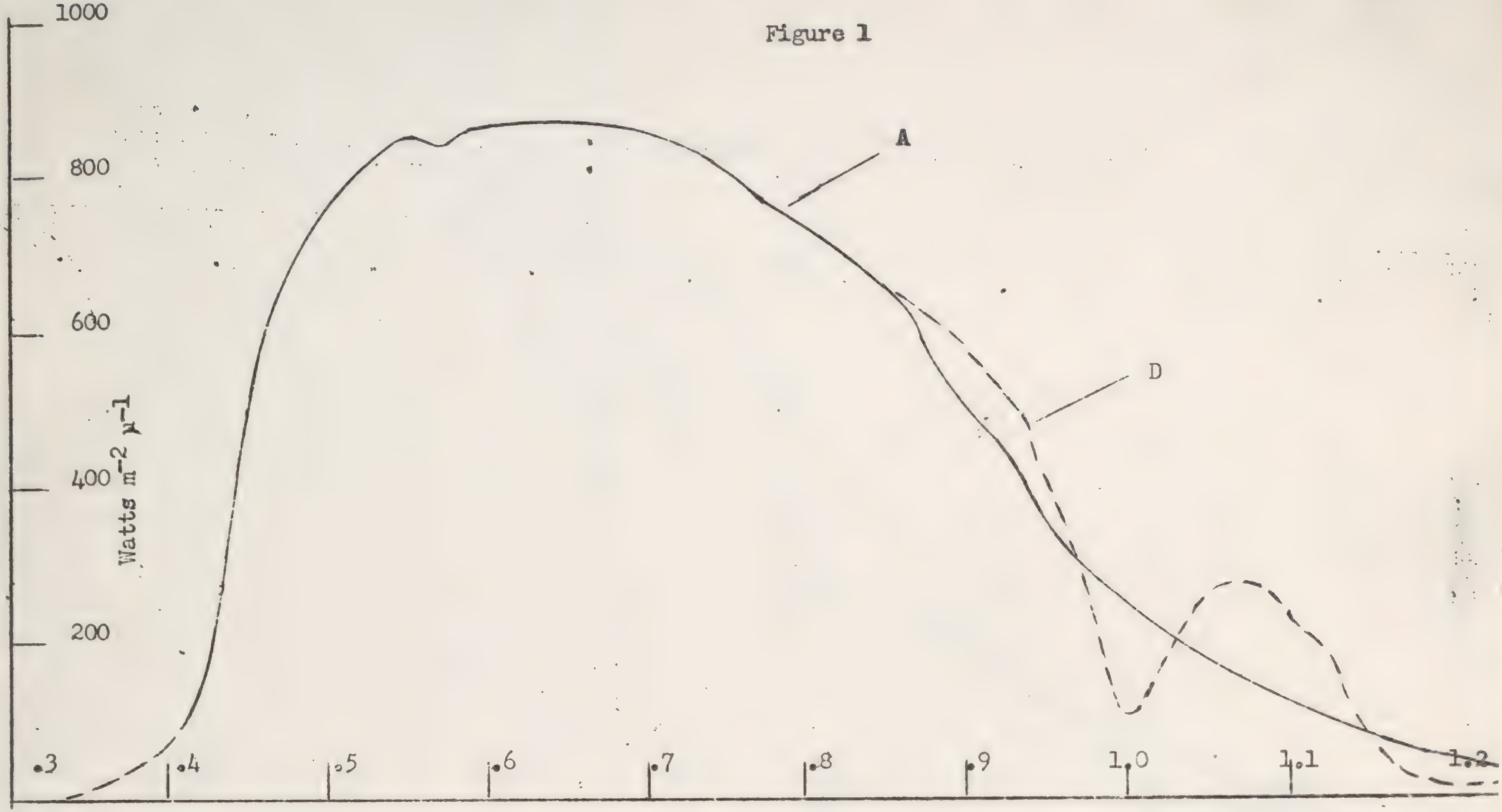
Wavelength, λ in μ	$(I_{s\lambda} O_\lambda)$ watts m^{-2} μ^{-1}	Wavelength, λ in μ	$(I_{s\lambda} O_\lambda)$ watts m^{-2} μ^{-1}
0.30	0	.70	840
0.31	0	.71	830
0.32	0	.72	820
.33	0	.73	820
.34	0	.74	810
.35	10	.75	790
.36	20	.76	770
.37	30	.77	760
.38	40	.78	750
.39	60	.79	740
.40	80	.80	720
.41	110	.81	710
.42	200	.82	690
.43	300	.83	680
.44	430	.84	660
.45	580	.85	650
.46	640	.86	620
.47	680	.87	600
.48	720	.88	560
.49	750	.89	530
.50	780	.90	500
.51	800	.91	480
.52	820	.92	450
.53	830	.93	410
.54	840	.94	380
.55	840	.95	350
.56	830	.96	320
.57	840	.97	300
.58	850	.98	280
.59	860	.99	260
.60	860	1.00	240
.61	860	1.01	230
.62	860	1.02	210
.63	860	1.03	200
.64	860	1.04	190
.65	860	1.05	180
.66	860	1.06	170
.67	860	1.07	160
.68	850	1.08	150
.69	850	1.09	140

Table 1 (Continued)

PROPOSED CURVE FOR CALCULATION OF SOLAR ENERGY AT THE RETINA

Wavelength, λ in μ	$(I_{s\lambda} O_\lambda)$ watts m^{-2} μ^{-1}	Wavelength, λ in μ	$(I_{s\lambda} O_\lambda)$ watts m^{-2} μ^{-1}
1.10	130	1.20	50
1.11	120	1.21	50
1.12	110	1.22	40
1.13	100	1.23	40
1.14	90	1.24	30
1.15	80	1.25	30
1.16	80	1.26	20
1.17	70	1.27	20
1.18	60	1.28	10
1.19	60	1.29	10
		1.30	0

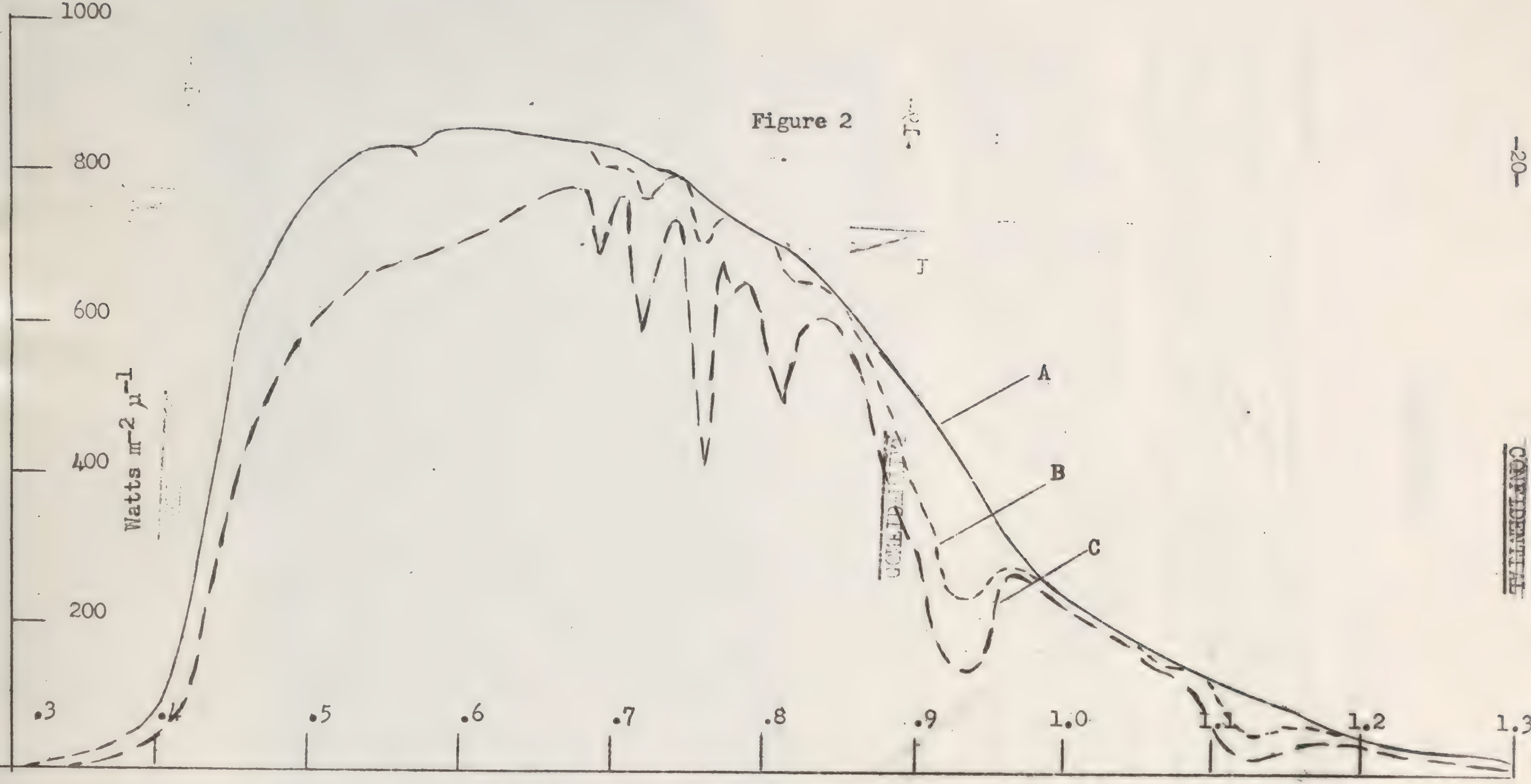
Figure 1



Values of $I_{s\lambda}\,O\lambda$. Curve A is from the data of Table 1. Values of $I_{s\lambda}$ for air mass 1, dry air, from the data of Moon[1]. Values of $O\lambda$ for the visible, from Ludvigh and McCarthy[2]; for the infrared, after Roggenbau and Wetthauer's data for the ox eye. To obtain curve D, transmissions of 23 mm. of water were substituted for $O\lambda$ in the infrared.

Wavelength, λ in μ

Figure 2



Curve A, same as Curve A in Figure 1. Curve B and C obtained by substituting values $I_{s\,\lambda}$ for air containing 20 mm. precipitable water, B air mass 1, C air mass 2.

Wavelength, λ in μ

Discussion:

The secretary asked whether it is now possible to make recommendations concerning the safety limits for transmission of total energy in sun scanning goggles and sights. It was the concensus that cautious experiments on human eyes are still necessary but that the calculations might take the place of further animal experimentation in determing the energy levels to be employed.

Dr. Hecht questioned the advisability of continued use of the present issue of Variable Density Goggles which were designed without regard to present findings. Although such goggles appear to be dangerous in the light of this additional information, no complaints have been received. It is possible that the visual discomfort of looking through them at the sun has prevented their use for sun-scanning.

The Bureau of Aeronautics is initiating a research project involving observers scanning in the region of the sun. In this connection Lt. Comdr. Leavitt wanted to know how close an observer can get to the sun in naked eye scanning. Dr. Miles said that it is possible to get within about 5° for a moment or two when viewing binocularly, but if viewing monocularly with the sun obscured, the observer can get within $.5^{\circ}$ to $.25^{\circ}$ of the sun. He and Lt. Comdr. Peckham offered to provide the project observers with goggles having an occluding spot to enable them to get close to the sun and to assure uniformity of scanning technique.

Lt. Chapanis proposed the special problem of ultraviolet radiation at high altitudes. Conflicting opinions have been expressed on the subject. Theoretically, the ultraviolet will be much greater at high altitudes than at low because the ozone diminishes in concentration as the altitude is increased, but Dr. O'Brien has stated that the radiation is not great until extremely high altitudes are reached. The problem is further complicated by the variability in transmission of colored plastics.

Lt. Comdr. Peckham observed that the symptoms of ultraviolet burns are easily recognizable and suggested that efforts be made to determine whether any harmful effects have been reported before research is undertaken. Lt. Chapanis explained that such an investigation is being made, but felt that calculations of the limit of transmission necessary for safety should proceed simultaneously with this investigation. The question was referred to Dr. Blum for study.

5. EFFECT OF PROLONGED BRILLIANT ILLUMINATION ON SUBSEQUENT DARK ADAPTATION

Digest of discussion:

Dr. Hecht reported preliminary experiments on the influence of prolonged bright illumination on subsequent dark adaptation. He wished to withhold his recommendations until a more detailed report can be made (Minutes, second meeting, item 8c, p. 5), but he indicated that complete adaptation may be delayed for as much as twelve or more hours in some observers. Further studies of individual differences will be made, and the effect of exposure day after day will be determined.

Dr. Lanier and Lt. Sulzman called attention to the fact that radium plaque test results are better when the test is given at night, although the procedure for dark adapting the subjects is the same in day and night testing. Dr. Hecht thought that these differences might be caused by exposure to different illuminations before dark adapting for the test. His findings may also account for the low retest correlations in some adaptometer data.

6. SUN GLASSES

The following questions were presented by Capt. Tousey as a guide to the procurement of sun glasses by QMG:

1. Under conditions of general issue should sunglasses be considered "Luxury Items" or a military necessity?

2. In what areas and under what conditions should sunglasses be issued?

3. What are the minimum optical standards for sunglass lenses?

4. What is the optimal total transmission in ultraviolet? Infrared? Visible?

5. What is the optimal color for lenses?

6. What restrictions to the field of vision, as offered by present military and commercial models of sunglasses, are considered undesirable?

7. How important is the reduction of rear reflection as effected by flat lenses, curved lenses or side shields?

8. Are polarizing lenses preferable, acceptable, or undesirable?

Members were requested to write out replies and notes for each of the questions on which they felt qualified.

7. TEST PROCEDURE FOR INSPECTION OF CURVED TRANSPARENT PLASTIC

Digest of discussion:

The Committee was asked to consider the following request presented by Lt. Comdr. Leavitt.

> "The Plastic Section of the Equipment and Materials Branch of the Engineering Division, Bureau of Aeronautics, has asked me to present for informal discussion the problem of devising a simple and practical test procedure whereby an aircraft inspector might judge the acceptability of curved transparent plastic forms with respect to identifying and measuring distortion of and interference with the vision of flying personnel. The maximum degree of distortion and interference considered acceptable would be a matter of military decision. Such a test procedure, if acceptable to Army and Navy aviation, would be considered for inclusion in an AN Specification on the optical requirements for formed transparent plastic sheet."

Lt. Chapanis pointed out that an Army-Navy-Industry conference was held at Wright Field in an effort to establish a basis for formulating acceptable values of deviation and resolution. Dr. Wright expressed the opinion that practical tests for the use of inspectors could be devised without too great difficulty.

The chairman announced that a Subcommittee would be appointed to consider this problem if further information showed there was a need for it.

8. NIGHT VISION - SCOTOMETRY

Digest of discussion:

Captain Korb reported on the work of Air Commodore Livingston of the Royal Air Force, who has for several years been studying Night Vision Scotometry. His work has progressed sufficiently to make some definite conclusions. He finds that when the visual field is charted on a completely dark adapted individual, with a target whose luminosity is considerably below the intensity of the photopic level, he is able to separate those who have good vision at night from those whose vision is poor. His findings indicate that all individuals who see well at night, when tested by this method, have a very small central scotoma and a normal visual field, and that those individuals who have poor night vision have a large central scotoma with a constriction of the visual field. If this is true, it would provide an easy method of determining the ability of a man to see at night, as it takes less time to chart the central scotoma than to make the adaptometer test. A recent article by Air Commodore Livingston* gives the details of his technique and findings.

Captain Korb reported this work to the Committee in order to stimulate interest in setting up a project to determine whether or not this technique is applicable for use in the Services.

The secretary reported that a study of visual fields in the dark adapted state from the School of Aviation Medicine, Randolph Field,** tends to corroborate Air Commodore Livingston's report. The findings indicate that the size of the central scotoma increases with decreasing illumination and that there is apparently a correlation (not computed) between the Hecht adaptometer threshold and the size of the scotoma. Another point brought out by this report is that the size of the scotoma for a light target on a dark field is one half that for a dark target on a light field.

Captain Shilling suggested that a project be initiated to check the results, but it was felt that before such action is taken, Dr. Wald's opinion on the subject should be obtained.

*Livingston, P. C., The form and character of rod scotometry. Amer. J. Ophth., 1944, 27, 349-353, 428 (April)

**Visual fields in the dark adapted state. School of Aviation Medicine, Randolph Field, Texas, Project 35, Research Report 1, December, 1942.

9. NIGHT LOOKOUT PROCEDURES

The following statement was prepared and presented by Dr. Wedell.

The purpose of the recent study made aboard ship by W.C.H. Prentice and C. H. Wedell of NDRC Project N-115 was two-fold: first, to study the problems encountered by lookout officers under operating conditions, to obtain suggestions for a more efficient organization, and to study the attitudes of the lookouts toward the job; second, to obtain data concerning the performance of lookouts which would make it possible to answer such questions as "How consistent are lookouts?" "How much difference is there between a good and a poor lookout?" and "How far can lookouts see under various weather conditions?"

The data were obtained by having one of the investigators call each lookout in turn, beginning 15 to 30 minutes after the change of watch. (Night lookouts only were studied.) The lookout was asked to scan his sector and report the relative bearing of the most distant target he could see. The investigator then obtained the range of this target from the radar operator. At the same time, the other investigator, who was stationed on the deck, measured the illumination of the sea and sky in the sector in question with a low-brightness meter. The data are being analyzed and a report will soon be issued.

The quantitative results mentioned above are of somewhat limited significance because of the conditions under which they were obtained. However, the following conclusions concerning the lookout situation on surface ships suffer from no such restriction. They are the result not only of the shipboard study but of interviews with a great many experienced Naval officers recently returned from sea duty.

The lookout problem can be conveniently analyzed into four parts as follows:

1. Problems of shipboard organization.
2. Problems of motivation, morale, and the prestige of the job.
3. Problems of training.
4. Problems of selection.

When Project N-115 was set up, its representatives felt that the selection problem was a major one. The studies that have been made have convinced us that the most important problem is that of motivation and the prestige of the job, with the problem of shipboard organization coming a close second. The selection problem

is of minor importance. At the present time, lookouts are only too frequently seamen 2/c who either do not desire to strive for a rate or who have not been allowed to. The job seems to them uninteresting and dull, and they see no future in it. They hear protestations by the ship's officers that they are important, that they are the "eyes of the ship," but the actual behavior of the officers seems to belie the statements. Unless something is done to improve the morale of the lookouts, devices such as red goggles and sun goggles will continue to be used in a desultory manner, and the training obtained on land will continue to be neutralized by the low prestige of the job.

Some kind of lookout "rate" seems to us the solution. It is realized that there is no substitute for the energetic and conscientious officer, but the establishment of a rating system for lookouts would go far toward convincing both officers and men that the job is regarded by the Navy as being at least as important as that of signalman, radaroperator, etc.

Discussion:

The Committee agreed that some means of rewarding lookouts should be recommended. Lt. Comdr. Burroughs reported that an arm badge had been designed and submitted to the Bureau of Naval Personnel. Dr. Wedell doubted that this would be the solution, pointing out that many of the men would object to wearing such a badge as it would merely mark them more plainly as seamen second class.

Lt. Dyson remarked that the report confirmed his own conviction that organization and motivation are the important factors in the lookout problem and proposed that incentive be a chance for promotion to a better job rather than a badge. Members objected to motivation that places emphasis on getting out of the job since some lookout duty is part of every job on shipboard.

Lt. Snidecor suggested that a positive motivation might be obtained by a requirement that one of the qualifications of a petty officer be proficiency as a lookout. Dr. Prentice agreed that this might be an effective solution, but the administrative difficulties involved would make it impractical.

Opportunity for promotion while remaining a lookout would be the best solution, but the job seems so simple that a rating for it might be difficult to establish. Dr. Miles thought that if some obvious element of complexity, such as the use of technical equipment, could be introduced into the duties, a rating could more easily be secured.

10. RECOGNITION TRAINING

B. History of Recognition Training in U. S. Naval Aviation

Lt. C. D. Coffman

In the spring of 1942 the Aviation Training Division of the Bureau of Aeronautics decided to train about 90 Naval officers as instructors in nomenclature and recognition of ships and aircraft in pre-flight schools and primary air stations. The officers selected were sent to Ohio State University for a two weeks course in a system called the "flash exposure" method of recognition training. This system consisted briefly of projecting slides at exposures of from 1/5 of a second to 1/100 of a second. The principles were simple -- this short exposure forced "seeing-as-a-whole" and forced student attention. These principles are still considered sound.

When it was learned that there were officers with this special training, a demand arose from Naval Aviation activities for recognition officers since frequent mistakes were being made in the fleet. It was decided to start a two month program at Ohio State for training these officers and this program began September 1, 1942. Demands began to come in for these officers from other fleet units and on January 1, 1943, the Bureau of Personnel took over the operation of the school at Ohio State and began training officers for the Navy's surface forces. This school is still in operation, and, at the present time, there are 580 recognition officers in Naval Aviation activities and over 2000 in the surface forces.

New training ideas began to develop as these men went out and gained practical experience, and changes were made in the program. The extensive pictorial slide coverage had used for some time exclusively close-up views of the object under study. Many distant views were developed and distributed on both planes and ships, and, for these, the exposure speeds were cut to no faster than 1/2 second. (In training for recognition of ships, even in close-ups, many instructors had cut their speeds to as slow as 3 seconds.)

A program of moving pictures consisting of three types of films was inaugurated in conjunction with the Army and the British: first, presentation type, an elementary film on one plane, running about six minutes, presenting close-up flying views, explanatory dialogue and animation, and some distant flying views; second, quizcraft type, a film for more advanced use running about twelve minutes, covering five or six planes in distant flying views, concluding with a close-up view and dialogue telling what the plane is; third, testcraft type, a film only for most advanced use, running about twenty minutes, showing brief, difficult, distant flying views of forty different aircraft, with a pause between planes long enough to permit jotting down the name of the plane by the student. At the end of the film the correct answers are given.

The Army developed widespread use of the shadowgraph, which the Navy has now adopted; NTS (Recognition) Ohio State has experimented extensively in the use of models, sketching, and night vision in lookout training; and the Special Devices Division of the Bureau of Aeronautics has developed devices for use outside the classroom.

At the present time, the short exposure is still the basis of recognition training in the Navy, supplemented and augmented by the new methods and devices mentioned above. The Chief of Naval Air Training is now preparing a new syllabus directing the utilization of these new training media, and in the fleet training stage the relation of closely integrated subjects is stressed, viz: identification signals and procedures, range estimation in gunnery, procedure for reporting sightings, etc.

Recognition training in Naval Aviation is continuous from the earliest training stages on through. The fleet and aviation personnel receive constant refresher training. In order to keep instructors up-to-date on the most recent teaching techniques and materials, two refresher schools for instructors have been established, one at Norfolk, the other at Alameda. A one-week course is given with demonstrations and practice with all new devices, visits to and inspections of ships and planes, and lectures on related work by combat-experienced personnel in the fields of intelligence, gunnery, and radar.

The present staff in Washington is 50-50 combat-experienced personnel and training command personnel, in an endeavor to keep recognition balanced from both points of view. All pictorial material now under development attempts to picture as closely as possible actual combat conditions.

Staff recognition officers are attached to all the major fleet aviation commands as sources of equipment and information to recognition officers in the fleet and as sources of pictorial and intelligence material for Washington for use in the overall program.

C. Recognition and Lookout Training Program at Naval Training School (Recognition)

Lt. H. B. McFadden

1. The program of Naval Training School (Recognition) is designed to train officers and men as spotters and teachers of recognition and to train for assumption of duties in connection with training and supervising lookouts. The course is of approximately eight week's duration. This school has been training officers and men of the Army, Navy, Coast Guard, and Marine Corps continuously since September, 1942. The lookout portion of the program was begun in October, 1943, and was set in as a full course for the class which graduated on 11 February 1944. The various parts of the training program have been in process of continuous development.

2. At present the course of instruction is divided into eight topics. These topics, and the content of each, are as follows:

a. Recognition.
Planes - approximately 120
Ships - approximately 120. This includes both combatant types and merchant ships. The number of recognition items varies according to obsolescence and the production of new units.

b. Air and Naval Forces.
Current war events.
The history, constitution, and operations of the major belligerent air and naval forces.

c. Lookout.
Topics of lookout training and supervision.
The use of battle telephones.
Lectures on observation and vision.

d. Principles of Recognition Training.
Discussion of specific problems likely to be encountered by the lookout-recognition officer.

e. Practice Teaching.
Coaching in the techniques of teaching.

f. Training Aids.
Sources, availability, operation, and maintenance of recognition and lookout reference and training materials and equipment.

g. Special Training Techniques.
Variations in training methods and equipment.

h. Sketching.
Elements of sketching.

3. Several technical problems face us. They are best stated in the form of questions. What are the limits of visual recognition under conditions of reduced visibility? What method and equipment can be used to train in recognition at these limits? What are the range limits at which visual contact can be made under conditions of reduced visibility? How best train for making visual contact at these limits? What visual aids, such as filters, are necessary and valuable to the lookout? Exactly, how should such aids be employed? Recommendations on the above for both shipboard and shore training are needed. It is understood that lookout training manuals for shipboard and shore use are in process. It is expected that many more questions, and perhaps some of the above, will be answered in those manuals

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D. Recognition Training in the Army Air Forces

Major Claude M. Terrell

1. Principles of Instruction

In the Army Air Forces, recognition training has been predicated on the theory that in visual education, as in all forms of education, there are certain basic factors of sound instruction which must be applied if the objective is to be attained. As prescribed by present AAF directives and training manuals, these basic factors may be outlined as follows:

a. In training the student to know and recognize shapes, there is no one "method", "system", or "device" which should be used to the exclusion of other good material or other sound educational and training practices.

b. The interest of the student must be aroused and maintained. Recognition can become a fascinating hobby, but only if the student finds the subject properly "tied in" to his normal duties in combat. This means that, in teaching the subject, facts, statistics, performance data, and interest stories become a vital part of training. The Recognition Journal, issued monthly by the War and Navy Departments, assists immeasurably in performing this function, while Recognition Instructors Information Letters, issued periodically by Training Aids Division, bring the latest available material directly to instructors.

c. The instructor must be well trained. In addition to being familiar with teaching techniques and procedures, he should be able, for example, to "talk shop" with pilot or air-crew

personnel and must be an authority on his subject if he is to command the attention and respect of his students.

d. Shapes are learned in four steps, which set the basic pattern for classroom procedures. These are: the presentation of the shape, study, review, and testing.

e. A proper syllabus must be prepared for each course in order to lay out in a carefully planned form the material to be presented and studied. It is better to teach a few objects well than a great many only partially.

f. The ultimate objective of recognition training is the recognition of aircraft, ships, or armored vehicles at the maximum possible distance. To achieve this, however, the student must first learn shapes at close ranges. To accomplish this, recognition is generally treated in three stages: elementary, intermediate, and advanced.

2. Implementation of Program of Instruction

The AAF program is implemented in three ways: training directives, training materials, and training devices. We shall discuss them in that order.

a. Training Directives

On 13 November 1943, the Assistant Chief of Air Staff, Training, issued a directive to the continental commands and air forces that accomplished four objectives: First, it established a Class A training list of the 40 most important operational aircraft and a Class B list of operational aircraft of secondary importance to be studied if time is available; Second, it directed the appointment of a recognition supervisor for each command and continental air force; Third, it directed the Training Command to conduct recognition training in such a manner as to enable its graduates to attain satisfactory standards of proficiency; Fourth, it directed the phasing of the recognition training program so as to provide coordination of the different stages of training.

Subsequently, further directives were issued providing for (a) aircraft training lists for flexible gunners and ground personnel, (b) teaching naval and merchant ships by types, and (c) training list of most important armored vehicles. The aircraft training lists will shortly be further revised in accordance with the current situation.

Pursuant to these directives from Headquarters, AAF, and directives from the individual commands and air forces, recognition training has been phased and coordinated along the following general lines:

(1) Pilots

	Hours on Aircraft	Hours on Ships	Hours on Armored Vehicles
Preflight	29	12	1
Primary	6	3	
Basic	$5\frac{1}{2}$	3	$\frac{1}{2}$
Advanced	6	3	
Transition	Recognition training in Transitional Schools is only given if the cadet fails to pass a Pre-Test. In such cases, 4 hours is given in single-engine schools, and 6 hours in twin-engine schools. Time is divided approximately 60% to aircraft and 40% to ships.		

(2) Bombardiers and Navigators

Same as for pilots in preflight, with an additional 13 hours in bombardier schools, and 10 hours in navigator schools, divided approximately 70% to aircraft and 30% to ships.

(3) Flexible Gunners

In flexible gunnery schools at present, approximately 10 hours are devoted to aircraft recognition. For students who come from technical schools, this represents an addition to recognition training already received there.

(4) Air crew personnel in continental training air forces

Although the amount of training varies a great deal between the different air forces and between fighter pilots and bomber air crews, a substantial amount of time is devoted to advanced recognition training, predominantly on aircraft.

(5) Ground Personnel

One hour of recognition training is given at basic training centers. Twenty-four (24) hours training is given in technical courses, with an additional 10 hours in advanced technical courses. Twelve (12) hours of training is given in Overseas Replacement Depots. Substantially all of this training is devoted to aircraft.

These directives are supplemented by the AAF Manual, Instructor's Guide for Recognition Training in the AAF, which describes the official methods, the available aids, and ways of using them. War Department "Recognition Training" Manual (FM 21-80) has also now become available and should prove helpful, particularly as it treats the problem more from the ground point of view.

b. Training Materials

These include principally silhouettes, photographs, models, and training films.

Silhouettes - These are the three-view basic "blueprint" or engineering drawings especially adapted for recognition purposes. They are the basis for all recognition instruction, and must be used in any recognition course. Silhouettes appear on posters, slides, recognition manuals, and in the Recognition Journal.

Photographs - Photographs are used in training to integrate the three silhouettes and to make the students familiar with the object from all views. Generally speaking, photographs are available in slides, balopticon flash cards, recognition manuals, and in the Recognition Journal.

Models - Scale models are of great value, not only because they show the relative sizes of different types, but also because they allow the student to see any view of a given object without being subject to the limitations of photographs which cannot possibly cover every angle of view.

Films - Recognition training films, averaging 6 to 10 minutes in length, are extremely useful as they assist immeasurably in the transition from the classroom to the field. Films approximate actual flying conditions more closely than any other training media. Pursuant to the coordinated program of the Army, Navy, and British, there are rapidly becoming available recognition films on operational aircraft of the following types:

Presentation type - for use in elementary training
Quizcraft type - for use in intermediate training
Testcraft type - for use in advanced training

It is considered that there is not yet a pressing need for recognition films on ships and armored vehicles. However, a few of such films are available and a coordinated program is being studied.

c. Training Devices

These include the Flash Shutter and Slide Projector, the Opaque Projector, and the Shadowgraph.

Flash Shutter and Slide Projector - Utilizing short exposures of slides on the screen, the Flash Shutter is an extremely useful device for heightening competition and interest in the classroom and for testing. However, claims, originally made for this device, that it widened the angle of vision and that it solved all problems

of recognition training are not now considered valid. Digit and counter slides are no longer being used. Exposures faster than 1/10th of a second do not actually represent an increase in difficulty and are not now regularly used in teaching; while extreme distance views often require a 3-second or longer exposure. Nevertheless, this valuable equipment is in use throughout the AAF, and serves as the basic recognition training kit. Approximately 3500 slides are available.

Opaque Projector - The ordinary slide projector is limited to use of available slides. The Opaque Projector (sometimes called Balopticon, Episcope, and Epidiascope), on the other hand, can utilize almost any photograph or printed material from current aviation magazines and journals. Although the Opaque Projector does not give as bright an image as the slide projector, this disadvantage is compensated for by its flexibility. Both types of projector have their place in a well rounded recognition course.

Shadowgraph - This "device" can be improvised with a sheet and a light source arranged in front of the classroom so that the shadow of a model can be "projected" onto the sheet. In this way, every possible angle of the model can be shown. It is particularly helpful with aircraft as motion can be thus introduced into the instruction. It is the most useful means available for both teaching and testing in recognition when using models.

3. Testing

One of the most difficult problems in the training program is the development of a valid and practicable method of standard tests to determine whether the student has attained the required degree of proficiency in recognition of actual aircraft in flight. Due to unavailability of actual aircraft, testing, like training must be "synthetic". Slides, at varying shutter speeds, depending upon the difficulty of the view are now generally being used for testing. Slide tests, however, have many disadvantages, including that of requiring a large number of slides not used previously for instruction. A set of test slides of varying difficulty for different phases of training is now under development by Training Aids Division. A number of printed test sheets containing small photographs and sillographs have been prepared and distributed by Training Aids Division and have been successfully used.

A moving picture film (TF 1-3368 - "Aircraft Recognition Proficiency Examination, Forms A and B") has been produced with the collaboration of Psychological Test Film Unit at Santa Ana. The use of this film as a testing medium will shortly be evaluated in a coordinated testing program in the Training Command. The film test, however, is subject to many administrative disadvantages due to the time and effort involved in keeping such a test film up to date with

current training lists. It is hoped that some form of standard testing procedure will result from this development work.

4. Research and Experimental Work at Santa Ana

The Psychological Test Film Unit at Santa Ana has recently accomplished considerable experimental work on recognition training. Reports of this work on the most important matters so far completed, indicate, among other things, substantially the following:

a. There is little difference in results as between teaching by "total form" and by "distinguishing features". When proficiency is measured by slide examination, there may be a slight disadvantage in teaching by "total form".

b. Use of flash shutter speeds over 1/10th of a second are of no particular value in producing greater recognition efficiency.

c. Use in teaching of technique of immediate confirmation and correction of responses leads to better results than otherwise.

d. Use of digit and counter slides does not increase recognition efficiency.

e. There is little difference in result between presenting similar and dissimilar aircraft together in sequence.

f. Simulated range in slides depends on size of image in the field on the screen but depends only to a slight degree on distance of observer from the screen.

g. Slides are a poor test of recognition proficiency.

h. Printed photographic test sheets have satisfactory reliability as a testing medium.

i. Motion picture tests are recommended as the best testing medium.

5. Summary

To summarize: In the AAF, the visual objectives of recognition training are achieved by a coordinated and directed program which provides the instructor with every reasonably available recognition aid and material to enable him to make his subject interesting enough for his students to want to learn it. In general, it has been our experience that the purely visual aspects of this very visual subject must be supplemented with interesting facts and data to make the training effective. Furthermore, although the recognition training program has been a unique experiment in the teaching and learning of form and shape through vision, it is interesting to note that it has always been necessary fundamentally to base it on accepted principles of general education.

In developing the program, there has been a considerable amount of coordination between Army Air, Ground and Service Forces, Navy, R.A.F, R.C.A.F., and British Army. Training lists, time available and individual instruction may vary, but it is believed that fundamentally all services utilize substantially the same training methods and aids. The Recognition Subcommittee of the Joint Clearing Committee on Army and Navy Training Aids, on which the various services are represented, affords a medium for constant interchange of information on the subject. As a result, many of the recognition materials are prepared jointly by the services and used by all of them respectively, such as the Recognition Journal, Pictorial Manuals (FM 30-30, FM 30-40, FM 30-50), models, slides, posters, and training films. Further experimentation and development work which is always in process will no doubt result, from time to time, in further improvement of instruction and training materials. No attempt has been made herein to enumerate or describe individual items of available training materials on aircraft, ships, and armored vehicles. This information appears in lists circularized from time to time by Training Aids Division.

E. Selected Experiments in Aircraft Recognition Training From the Psychological Test Film Unit, Army Air Forces

Dr. William O. Jenkins

The following experiments in the field of aircraft recognition training were selected from a series of such studies performed by the Psychological Test Film Unit of the Aviation Psychology Program located at Santa Ana, California.

I

The Effectiveness of Emphasis on Total Form Versus Emphasis on Features in Aircraft Recognition Training. - An experiment was conducted to compare the effectiveness of classroom instruction emphasizing (a) the total form of the airplanes being taught and (b) the features of the airplanes. Two groups of about ninety preflight cadets were matched on the basis of scores on a pre-test of twenty slides of American aircraft. Both groups were tested at the conclusion of training with a slide examination containing forty-five slides of the airplanes studied and with the Aircraft Recognition Proficiency Test, Preflight Level, a motion picture test containing 100 views of these airplanes in flight. The critical ratios of the difference between average scores of the two groups were: on the slide examination, 2.4, and on the motion picture test, 1.5, with a higher score for the group trained on features. For the slide examination the critical ratio indicates that a difference of this size between the scores of the two groups could occur by chance between one and two times out of 100 and is, therefore, on the border-

line of statistical significance. These results suggest that there is a slight disadvantage in effectiveness for recognition training of the technique of total form emphasis when proficiency is measured by means of the final slide examination.

II

The Effectiveness of Rapid Flash Speeds in Recognition Training. - An experiment was performed to measure the effect of using various exposure speeds during review training on recognition proficiency in the thirty hour course in preflight school. Three groups of about 170 men were employed. The first group was trained at 1/10th second throughout the course. The second group was trained at 1/10th second flash speed throughout except for the first few hours of instruction in which 1/5th second exposures were employed. The third group was adapted to an exposure speed of 1/50th second by the end of eight class hours, in which the exposure speed was gradually increased from 1/5th to 1/50th seconds. All other training conditions were the same for the three groups. The recognition proficiency of each group was measured by means of a final slide examination and by the Aircraft Recognition Proficiency Test, a motion picture test showing 100 planes in flight. The sixty slides of the final slide examination were divided into three sets of approximately equal difficulty. Each group was divided into thirds so that one third of each group saw the slides of Set A at one second, Set B at 1/10th second, and Set C at 1/50th second; one third saw Set A at 1/50th second, Set B at one second, and Set C at 1/10th second; and one third saw Set A at 1/10th second, Set B at 1/50th second, and Set C at one second. The differences between average scores for the three groups on the motion picture proficiency test all yielded critical ratios below 1.1, indicating statistically insignificant differences. Similar results were obtained with the slide examination. When scores on the slide test given at any one speed are compared, the only statistically significant difference in score is between the slow trained and fast trained group when tested at 1/50th second exposure speed. This difference favors the fast trained group. The evidence from this experiment appears to indicate no particular value in split-second exposure of slides (1/10th or 1/50th second) as compared with longer exposures of one second in producing greater recognition proficiency.

III

The Effectiveness of Immediate Error Correction as a Technique of Review in Recognition Training.- An experiment was conducted to test the effectiveness of immediate confirmation and correction on the learning of the specific materials employed in aircraft recognition courses. The subjects were 280 aviation trainees divided into groups of thirty men each. All of the groups learned twenty slides of twenty unfamiliar foreign aircraft. One set of groups was shown each of the twenty slides for five seconds. The name of each plane was announced just before it appeared and was repeated while it was on the screen. On

the fourth presentation each slide was exposed for only 2.5 seconds and the trainees were instructed to write down the name of each plane. In the other set of groups, trial one was the same. On the second and third presentations, however, the slides were exposed for 2.5 seconds after which the trainees were required to identify each plane by writing down the name. Following this the same slide was exposed again for 2 1/2 seconds and its name was announced. The individuals who had made a correct response placed a check mark beside it. Those who had made an incorrect response or none at all were required to write down the correct name. The fourth presentation was conducted in a manner exactly similar to that employed in the first method. As measured by the average number of planes learned, the second groups which had the responses confirmed and corrected were statistically much superior to the first group. These results clearly indicate the importance of immediate confirmation and correction responses during the review period.

Discussion:

The discussion was opened by the presentation of the following memorandum prepared by Ens. Verplank:

"The procedure used almost universally by the U. S. Navy for the training of personnel in the recognition of ships and planes utilizes as training material photographs of the items to be learned, and the training procedure itself requires that these photographs be exposed for brief durations to the personnel under training.

"It is claimed that this system produces efficient learning, that it requires learning of "total form," and that it better fulfills the needs of the Navy for training in recognition than any other system.

"This situation would not be of any interest to the Vision Committee or to those working with lookouts, and other night personnel, except academically, if it were not for the fact that approximately one year ago the Bureau of Personnel combined the lookout and recognition training programs under the auspices of trained recognition officers. This step was taken because recognition officers trained at Ohio State were being assigned as "L" Division officers aboard vessels.

"In order to consolidate effectively the two programs, approximately 180 graduates of the NTS (Recognition) were sent to the Medical Research Laboratory, Submarine Base, New London, for training as Lookout Officers. Among these 180 were members of the staff of the NTS (Recognition) whose duty it was to return to Columbus and institute as part of the recognition training course a program of lookout training.

"Since this consolidation occurred, Recognition Officers have been responsible for the Lookout Training Program , and the Ohio State NTS (Recognition) has had the duty of training its students as "L" Division officers. However, investigation at training schools indicates that recognition officers are training all men in recognition and giving almost no lookout training; this is equally true on shipboard. Finally, the program of lookout training at the Ohio State NTS (Recognition) has over a period of months changed from its original form to a simple showing of the lookout training films with a "quiz" given immediately afterwards. Lecture material is occasionally read by instructors.

"At the same time, the NTS (Recognition) has developed an increasing program of recognition training for all personnel in the Navy, regardless of the needs of Naval personnel for such training, and concurrently almost no one under these recognition officers is told the fundamentals of lookout duty.

"It is not necessary that this emphasis on recognition training should exist. There is no reasonable need for the amount of training that is given, nor is there likely to be any such need. On the other hand, a very large percentage of all men in boot camps now, and in Class A schools, and at pre-commissioning schools will be standing lookout watches without having the proper understanding of their future duties.

"It is therefore strongly urged that a reorganization be considered which will insure that Naval personnel acquire greatly needed training and which will not waste valuable time teaching a skill which is of doubtful value to them."

Lt. Dyson stated that he had talked to Ohio State recognition officers sent to the Submarine Base for lookout training. He was in general agreement with Ens. Verplank's views but was more concerned with teaching than techniques of training. He felt that the crucial point is training good teachers who can adapt their methods to the needs of a particular situation.

There was considerable disagreement with Ensign Verplank's memorandum. Lt. Coffman objected to the generalized nature of the criticism. Air Forces personnel do get close enough to their targets to recognize them, and they need identification training. This distinction was not made in the paper, and he felt that the conclusions do not apply to the Air Forces training program.

Lt. McFadden explained that the Ohio State recognition program does not eliminate consideration of the lookout problem and that they have an excellent staff interested in improving their program through new information and cooperative planning. Lt. Comdr. Merrick, commenting that recent Naval engagements indicate that lookouts are doing a good job, asked for specific suggestions of ways to improve recognition training.

Dr. Wedell emphasized the need for teaching in terms of the requirements of the different services and different battle theatres, but reminded the group that the problem of shipboard organization is also important. Recognition officers, trained at Ohio State, may be good teachers, but training on shipboard is not given enough time to be effective nor is its potential motivational value exploited.

Captain Shilling, concerned especially with the problem of surface craft lookout, expressed the opinion that training in the use of the eyes is more important than recognition training. Since many who receive recognition training never use it, he suggested that it be eliminated from boot camp and placed at a higher level of training. He urged the group to consider the problems of how much weight should be given to each type of training when time is limited, how much recognition is possible at low levels of illumination, and to what extent the problem is one of administration.

Lt. Blackwell was opposed to the elimination of recognition training at the boot camp level since the limited time available later for such training makes it important that the persons being trained have some background on which to build. Although both lookout and recognition training are desirable, the emphasis on visual training should be kept to a minimum.

Lt. Snidecor stressed the need for consideration of the learning curve in relation to the time available in determining how much recognition training should be given in boot camp.

The question of whether recognition is possible at night was discussed at some length, and it was generally agreed that more information on the subject is necessary. Major Terrell expressed the opinion that if seeing at night is possible, the recognition problem should be very similar to that in daytime. Lt. Comdr. Leavitt was inclined to agree, pointing out that there is no difference between day and night camouflage except for different levels of illumination. He believed that it would be possible to calculate the recognition threshold as a fraction of the perception threshold.

Others warned against any assumption that daytime training in recognition is sufficient for night use; it is possible that features may be changed at different levels of illumination. Lt. Comdr. Peckham advocated practice in recognition at decreasing levels of illumination, but Lt. Coffman felt that time is lacking to train thoroughly under two sets of conditions.

Returning to the importance of lookout training, Captain Shilling commented that on submarines in daytime, lookouts spot 67 per cent of the objects encountered before the radar operator does, and at night it is probably 25 per cent. He asked for other suggestions for improving lookout training.

Dr. Duntley suggested that the use of two men scanning the same area and reporting hunches might increase the effectiveness of the lookout service since at threshold values, the object is seen only a certain proportion of the times (threshold = 50%), and since a guess of low subjective certainty is right more often than wrong. A somewhat similar practice is in operation, Lt. Comdr. Burroughs explained, since the lookout's report is checked by someone else. Officers must encourage hunches, however, in order to get the full benefit of the observers' eyes.

The work being done with the RCAF night vision trainer, which demonstrates the basic principles of the use of the eyes at night, was outlined by Lt. Older. As this device would be valuable for training in port, Lt. Dyson suggested that officers trained at Ohio State be made familiar with the Evelyn trainer. (Dr. Miles announced at the end of the meeting that he could provide samples of a monocular red goggle for use with the Evelyn trainer to demonstrate the loss of dark adaptation in one eye exposed briefly to illumination.)

In response to Lt. McFadden's question concerning the possibility of lowering the threshold by training, Lt. Comdr. Peckham and Lt. McCarthy agreed that seeing is learned by forcing one's self to see, and, consequently, is learned during recognition training. Dr. Lanier objected that present training methods with emphasis on recognition are confusing to lookouts because their job is to sight an object, not to recognize it. Dr. Wedell and Dr. Prentice stressed the importance of day to day shipboard training in actual battle areas.

Major Keller observed that training in night recognition is increasingly necessary as enemy planes will be encountered more and more at night. He hoped that a device to combine training in night vision and night recognition will be possible.

Lt. Britt suggested that a subcommittee be appointed to correlate lookout training with recognition training, and specifically to consider the following questions arising out of the discussion.

1. Is recognition possible under conditions of night illumination, and what are the limits of recognition in reduced illumination?

2. Is the task of night recognition sufficiently different from daytime recognition to require special training?

3. What methods and aids can best be used in training for night recognition, and what weight should be given to the various phases of the training?